

THAT WHICH IS CLAIMED IS:

1. A method of communicating with a plurality of application instances executing on a cluster of data processing systems having a plurality of communication protocol stacks associated therewith utilizing a single Internet Protocol (IP) address, the method comprising the steps of:

establishing a first of the plurality of communication protocol stacks as a routing communication protocol stack associated with the single IP address;

defining ones of the plurality of communication protocol stacks which are associated with the single IP address as candidate target communication protocol stacks;

distributing among the plurality of communication protocol stacks an identification of protocol stacks which are associated with the single IP address and an identification of the routing communication protocol stack;

notifying the routing communication protocol stack when an instance of the plurality of application instances associated with a candidate target communication protocol stack listens to a port of the single IP address so as to define the candidate target communication protocol stack as a current actual target stack;

receiving a request to establish a connection to the single IP address and the port of the single IP address;

establishing a routing table entry corresponding to the current actual target stack responsive to receiving a request to establish a connection to the single IP address and the port so as to define a routing path associated with the IP address and the port from the

routing communication protocol stack to the current  
actual target stack; and

5 routing communications for the connection to the  
port of the IP address received by the routing  
communication protocol stack based on the routing table.

10 2. A method according to Claim 1, wherein the step  
of defining ones of the plurality of communication  
protocol stacks which are associated with the single IP  
address as candidate target communication protocol stacks  
comprises the step of defining all of the plurality of  
communication protocol stacks of the cluster of data  
processing systems as candidate target communication  
protocol stacks.

15 3. A method according to Claim 1, wherein the step  
of defining ones of the plurality of communication  
protocol stacks which are associated with the single IP  
address as candidate target communication protocol stacks  
20 comprises the step of defining enumerated ones of the  
plurality of communication protocol stacks of the cluster  
of data processing systems as candidate target  
communication protocol stacks.

25 4. A method according to Claim 1, wherein the step  
of establishing a first of the plurality of communication  
protocol stacks as a routing communication protocol stack  
associated with the single IP address comprises the step  
of establishing a first of the plurality of communication  
30 protocol stacks as a routing communication protocol stack  
associated with the single IP address for routing  
communications associated with at least one specified  
port associated with the IP address;

35 wherein the step of defining ones of the plurality  
of communication protocol stacks which are associated

with the single IP address as candidate target  
communication protocol stacks comprises the step of  
defining ones of the plurality of communication protocol  
stacks which are associated with the at least one  
5 specified port associated with the IP address as  
candidate target communication protocol stacks;

wherein the step of defining ones of the plurality  
of communication protocol stacks which are associated  
with the single IP address as candidate target

10 communication protocol stacks comprises the step of  
distributing among the plurality of communication  
protocol stacks an identification of protocol stacks  
which are associated with the at least one port of the  
single IP address as candidate target communication  
15 protocol stacks and an identification of the routing  
communication protocol stack; and

wherein the step of notifying the routing  
communication protocol stack when an instance of the  
plurality of application instances associated with a  
20 candidate target communication protocol stack listens to  
a port of the single IP address so as to define the  
candidate target communication protocol stack as a  
current actual target stack comprises the step of  
notifying the routing communication protocol stack when  
25 an instance of the plurality of application instances  
associated with a candidate target communication protocol  
stack listens to the at least one port of the single IP  
address so as to define a current actual target stack.

30 5. A method according to Claim 4, wherein the at  
least one port comprises a plurality of ports identified  
in a port list associated with the single IP address.

6. A method according to Claim 4, wherein the at least one port comprises all ports associated with the single IP address.

5 7. A method according to Claim 1, further comprising:

notifying the routing communication protocol stack that the instance of the plurality of application instances associated with the candidate target communication protocol stack has terminated listening to the port of the single IP address; and

10 removing the routing table entry corresponding to the candidate target communication protocol stack so as to remove the routing path associated with the IP address, the port and the candidate target communication protocol stack.

15 8. A method according to Claim 7, wherein the step of notifying the routing communication protocol stack that the instance of the plurality of application instances associated with the candidate target communication protocol stack has terminated listening to the port of the single IP address comprises the step of sending a termination message through a cross coupling facility of the cluster of data processing systems.

20 9. A method according to Claim 1, wherein the steps of establishing a first of the plurality of communication protocol stacks as a routing communication protocol stack associated with the single IP address and defining ones of the plurality of communication protocol stacks which are associated with the single IP address comprise the step of incorporating a VIPADISTribute statement in a VIPADynamic definition block associated with the first communication protocol stack, wherein the

VIPADISTRIBUTE statement defines an IP address as a dynamic routable virtual IP address (VIPA), identifies ports associated with the VIPA which are routable, and identifies communication protocols stacks associated with the VIPA.

10. A method according to Claim 9, wherein the step of distributing among the plurality of communication protocol stacks an identification of protocol stacks which are associated with the single IP address and an identification of the routing communication protocol stack comprises broadcasting a list including the definitions of the VIPADISTRIBUTE statement.

11. A method according to Claim 1, further comprising the steps of:

notifying the routing communication protocol stack that a connection utilizing the single IP address and the port of the single IP address has terminated; and

removing the routing table entry corresponding to the connection to the current actual target stack so as to remove the routing path associated with the IP address, the port and the current actual target stack.

12. A method according to Claim 1, wherein the step of establishing a routing table entry is preceded by the step of selecting a current actual target stack so as to provide a selected communication protocol stack associated with the connection request; and

wherein the step of establishing a routing table entry corresponding to the current actual target stack responsive to receiving a request to establish a connection to the single IP address and the port so as to define a routing path associated with the IP address and the port from the routing communication protocol stack to

the current actual target stack comprises the step of establishing a routing table entry corresponding to the selected communication protocol stack associated with the connection request to provide a routing path associated with the IP address and the port from the routing communication protocol stack to the selected communication protocol stack.

13. A system for communicating with a plurality of application instances executing on a cluster of data processing systems having a plurality of communication protocol stacks associated therewith utilizing a single Internet Protocol (IP) address, comprising:

a routing communication protocol stack configured to receive communications to the single IP address and to forward to the received communications to a selected communication protocol stack from the plurality of communication protocol stacks;

a destination port table associated with the routing communication protocol stack which identifies communication protocol stacks having application instances bound to the single IP address and listening to a predefined port of the single IP address; and

a current routing table associated with the routing communication protocol stack which identifies routing paths from the routing communication protocol stack to a communication protocol stack associated with a connection utilizing the single IP address and the predefined port.

14. A system according to Claim 13, wherein the routing communication protocol stack is further configured to build the destination port table based on status messages received from communication protocol stacks of the plurality of communication protocol stacks having application instances bound to the single IP

18. A system according to Claim 13, wherein the predefined port comprises a plurality of predefined ports identified in a port list associated with the single IP address.

19. A system according to Claim 13, wherein the predefined port comprises all ports associated with the single IP address.

20. A system for communicating with a plurality of application instances executing on a cluster of data processing systems having a plurality of communication protocol stacks associated therewith utilizing a single Internet Protocol (IP) address, comprising:

means for establishing a first of the plurality of communication protocol stacks as a routing communication protocol stack associated with the single IP address;

means for defining ones of the plurality of communication protocol stacks which are associated with the single IP address as candidate target communication protocol stacks;

means for distributing among the plurality of communication protocol stacks an identification of protocol stacks which are associated with the single IP address and an identification of the routing communication protocol stack;

means for notifying the routing communication protocol stack when an instance of the plurality of application instances associated with a candidate target communication protocol stack listens to a port of the single IP address so as to define the candidate target communication protocol stack as a current actual target stack;

means for receiving a request to establish a connection to the single IP address and the port of the single IP address;

means for establishing a routing table entry corresponding to the current actual target stack responsive to receiving a request to establish a connection to the single IP address and the port so as to define a routing path associated with the IP address and the port from the routing communication protocol stack to the current actual target stack; and

means for routing communications for the connection to the port of the IP address received by the routing communication protocol stack based on the routing table.

<sup>14</sup>  
~~21~~. A system according to Claim <sup>13</sup>~~20~~, wherein the means for defining ones of the plurality of communication protocol stacks which are associated with the single IP address as candidate target communication protocol stacks comprises means for defining all of the plurality of communication protocol stacks of the cluster of data processing systems as candidate target communication protocol stacks.

<sup>15</sup>  
~~22~~. A system according to Claim <sup>13</sup>~~20~~, wherein the means for defining ones of the plurality of communication protocol stacks which are associated with the single IP address as candidate target communication protocol stacks comprises means for defining enumerated ones of the plurality of communication protocol stacks of the cluster of data processing systems as candidate target communication protocol stacks.

<sup>16</sup>  
~~23~~. A system according to Claim <sup>13</sup>~~20~~, wherein the means for establishing a first of the plurality of communication protocol stacks as a routing communication



protocol stack associated with the single IP address  
comprises means for establishing a first of the plurality  
of communication protocol stacks as a routing  
communication protocol stack associated with the single  
5 IP address for routing communications associated with at  
least one specified port associated with the IP address;

wherein the means for defining ones of the plurality  
of communication protocol stacks which are associated  
with the single IP address as candidate target  
10 communication protocol stacks comprises means for  
defining ones of the plurality of communication protocol  
stacks which are associated with the at least one  
specified port associated with the IP address as  
candidate target communication protocol stacks;

15 wherein the means for defining ones of the plurality  
of communication protocol stacks which are associated  
with the single IP address as candidate target  
communication protocol stacks comprises means for  
distributing among the plurality of communication  
20 protocol stacks an identification of protocol stacks  
which are associated with the at least one port of the  
single IP address as candidate target communication  
protocol stacks and an identification of the routing  
communication protocol stack; and

25 wherein the means for notifying the routing  
communication protocol stack when an instance of the  
plurality of application instances associated with a  
candidate target communication protocol stack listens to  
a port of the single IP address so as to define the  
30 candidate target communication protocol stack as a  
current actual target stack comprises means for notifying  
the routing communication protocol stack when an instance  
of the plurality of application instances associated with  
a candidate target communication protocol stack listens

to the at least one port of the single IP address so as to define a current actual target stack.

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24. A system according to Claim 16, wherein the at  
5 least one port comprises a plurality of ports identified  
in a port list associated with the single IP address.

18  
25. A system according to Claim 16, wherein the at  
10 least one port comprises all ports associated with the  
single IP address.

19  
26. A system according to Claim 13, further  
comprising:

means for notifying the routing communication  
15 protocol stack that the instance of the plurality of  
application instances associated with the candidate  
target communication protocol stack has terminated  
listening to the port of the single IP address; and

means for removing the routing table entry  
20 corresponding to the candidate target communication  
protocol stack so as to remove the routing path  
associated with the IP address, the port and the  
candidate target communication protocol stack.

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27. A system according to Claim 19, wherein the  
25 means for notifying the routing communication protocol  
stack that the instance of the plurality of application  
instances associated with the candidate target  
communication protocol stack has terminated listening to  
30 the port of the single IP address comprises means for  
sending a termination message through a cross coupling  
facility of the cluster of data processing systems.

21  
28. A system according to Claim 13, wherein the  
35 means for establishing a first of the plurality of

communication protocol stacks as a routing communication  
protocol stack associated with the single IP address and  
the means for defining ones of the plurality of  
communication protocol stacks which are associated with  
the single IP address comprise means for incorporating a  
VIPADISTribute statement in a VIPADynamic definition  
block associated with the first communication protocol  
stack, wherein the VIPADISTribute statement defines an IP  
address as a dynamic routable virtual IP address (VIPA),  
identifies ports associated with the VIPA which are  
routable, and identifies communication protocols stacks  
associated with the VIPA.

<sup>22</sup>  
~~25~~. A system according to Claim <sup>21</sup>~~28~~, wherein the  
means for distributing among the plurality of  
communication protocol stacks an identification of  
protocol stacks which are associated with the single IP  
address and an identification of the routing  
communication protocol stack comprises means for  
broadcasting a list including the definitions of the  
VIPADISTribute statement.

<sup>23</sup>  
~~30~~. A system according to Claim <sup>13</sup>~~20~~, further  
comprising:

means for notifying the routing communication  
protocol stack that a connection utilizing the single IP  
address and the port of the single IP address has  
terminated; and

means for removing the routing table entry  
corresponding to the connection to the current actual  
target stack so as to remove the routing path associated  
with the IP address, the port and the current actual  
target stack.

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20,

A system according to Claim 13, further comprising means for selecting a current actual target stack so as to provide a selected communication protocol stack associated with the connection request; and

5 wherein the means for establishing a routing table entry corresponding to the current actual target stack responsive to receiving a request to establish a connection to the single IP address and the port so as to define a routing path associated with the IP address and  
10 the port from the routing communication protocol stack to the current actual target stack comprises means for establishing a routing table entry corresponding to the selected communication protocol stack associated with the connection request to provide a routing path associated  
15 with the IP address and the port from the routing communication protocol stack to the selected communication protocol stack..

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32.

A computer program product for communicating  
20 with a plurality of application instances executing on a cluster of data processing systems having a plurality of communication protocol stacks associated therewith utilizing a single Internet Protocol (IP) address, comprising:

25 a computer readable storage medium having computer readable program code embodied therein, the computer readable program code comprising:

computer readable program code which establishes a  
30 first of the plurality of communication protocol stacks as a routing communication protocol stack associated with the single IP address;

computer readable program code which defines ones of  
the plurality of communication protocol stacks which are  
associated with the single IP address as candidate target  
35 communication protocol stacks;

computer readable program code which distributes among the plurality of communication protocol stacks an identification of protocol stacks which are associated with the single IP address and an identification of the routing communication protocol stack;

computer readable program code which notifies the routing communication protocol stack when an instance of the plurality of application instances associated with a candidate target communication protocol stack listens to a port of the single IP address so as to define the candidate target communication protocol stack as a current actual target stack;

computer readable program code which receives a request to establish a connection to the single IP address and the port of the single IP address;

computer readable program code which establishes a routing table entry corresponding to the current actual target stack responsive to receiving a request to establish a connection to the single IP address and the port so as to define a routing path associated with the IP address and the port from the routing communication protocol stack to the current actual target stack; and

computer readable program code which routes communications for the connection to the port of the IP address received by the routing communication protocol stack based on the routing table.

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23. A computer program product according to Claim 25, wherein the computer readable program code which defines ones of the plurality of communication protocol stacks which are associated with the single IP address as candidate target communication protocol stacks comprises computer readable program code which defines all of the plurality of communication protocol stacks of the cluster

of data processing systems as candidate target communication protocol stacks.

5 <sup>35</sup>~~32~~ <sup>27</sup>~~34~~. A computer program product according to Claim  
defines ones of the plurality of communication protocol  
stacks which are associated with the single IP address as  
candidate target communication protocol stacks comprises  
computer readable program code which defines enumerated  
10 ones of the plurality of communication protocol stacks of  
the cluster of data processing systems as candidate  
target communication protocol stacks.

15 <sup>35</sup>~~32~~ <sup>28</sup>~~35~~. A computer program product according to Claim  
establishes a first of the plurality of communication  
protocol stacks as a routing communication protocol stack  
associated with the single IP address comprises computer  
readable program code which establishes a first of the  
20 plurality of communication protocol stacks as a routing  
communication protocol stack associated with the single  
IP address for routing communications associated with at  
least one specified port associated with the IP address;  
wherein the computer readable program code which  
25 defines ones of the plurality of communication protocol  
stacks which are associated with the single IP address as  
candidate target communication protocol stacks comprises  
computer readable program code which defines ones of the  
plurality of communication protocol stacks which are  
30 associated with the at least one specified port  
associated with the IP address as candidate target  
communication protocol stacks;  
wherein the computer readable program code which  
defines ones of the plurality of communication protocol  
35 stacks which are associated with the single IP address as

candidate target communication protocol stacks comprises computer readable program code which distributes among the plurality of communication protocol stacks an identification of protocol stacks which are associated with the at least one port of the single IP address as candidate target communication protocol stacks and an identification of the routing communication protocol stack; and

wherein the computer readable program code which notifies the routing communication protocol stack when an instance of the plurality of application instances associated with a candidate target communication protocol stack listens to a port of the single IP address so as to define the candidate target communication protocol stack as a current actual target stack comprises computer readable program code which notifies the routing communication protocol stack when an instance of the plurality of application instances associated with a candidate target communication protocol stack listens to the at least one port of the single IP address so as to define a current actual target stack.

<sup>29</sup>  
~~28~~ <sup>26</sup>. A computer program product according to Claim ~~25~~, wherein the at least one port comprises a plurality of ports identified in a port list associated with the single IP address.

<sup>30</sup>  
~~28~~ <sup>27</sup>. A computer program product according to Claim ~~25~~, wherein the at least one port comprises all ports associated with the single IP address.

<sup>31</sup>  
~~25~~ <sup>28</sup>. A computer program product according to Claim ~~22~~, further comprising:

computer readable program code which notifies the routing communication protocol stack that the instance of

the plurality of application instances associated with the candidate target communication protocol stack has terminated listening to the port of the single IP address; and

5 computer readable program code which removes the routing table entry corresponding to the candidate target communication protocol stack so as to remove the routing path associated with the IP address, the port and the candidate target communication protocol stack.

10 <sup>32</sup>  
<sup>31</sup> ~~30~~. A computer program product according to Claim ~~30~~, wherein the computer readable program code which notifies the routing communication protocol stack that the instance of the plurality of application instances  
15 associated with the candidate target communication protocol stack has terminated listening to the port of the single IP address comprises computer readable program code which sends a termination message through a cross coupling facility of the cluster of data processing  
20 systems.

25 <sup>33</sup>  
<sup>25</sup> ~~32~~. A computer program product according to Claim ~~32~~, wherein the computer readable program code which establishes a first of the plurality of communication protocol stacks as a routing communication protocol stack associated with the single IP address and the computer readable program code which defines ones of the plurality of communication protocol stacks which are associated with the single IP address comprise means for  
30 incorporating a VIPADISTribute statement in a VIPADynamic definition block associated with the first communication protocol stack, wherein the VIPADISTribute statement defines an IP address as a dynamic routable virtual IP address (VIPA), identifies ports associated with the VIPA



which are routable, and identifies communication protocols stacks associated with the VIPA.

5 <sup>33</sup>~~40~~ <sup>34</sup>~~41~~ 41. A computer program product according to Claim  
10 wherein the computer readable program code which  
distributes among the plurality of communication protocol  
stacks an identification of protocol stacks which are  
associated with the single IP address and an  
identification of the routing communication protocol  
stack comprises computer readable program code which  
broadcasts a list including the definitions of the  
VIPADISTRIBUTE statement.

15 <sup>25</sup>~~32~~ <sup>35</sup>~~42~~ 42. A computer program product according to Claim  
further comprising:

computer readable program code which notifies the  
routing communication protocol stack that a connection  
utilizing the single IP address and the port of the single  
IP address has terminated; and

20 computer readable program code which removes the  
routing table entry corresponding to the connection to  
the current actual target stack so as to remove the  
routing path associated with the IP address, the port and  
the current actual target stack.

25 <sup>25</sup>~~32~~ <sup>36</sup>~~43~~ 43. A computer program product according to Claim  
further comprising computer readable program code  
which selects a current actual target stack so as to  
provide a selected communication protocol stack  
30 associated with the connection request; and

wherein the computer readable program code which  
establishes a routing table entry corresponding to the  
current actual target stack responsive to receiving a  
request to establish a connection to the single IP  
35 address and the port so as to define a routing path

associated with the IP address and the port from the  
routing communication protocol stack to the current  
actual target stack comprises computer readable program  
code which establishes a routing table entry  
5 corresponding to the selected communication protocol  
stack associated with the connection request to provide a  
routing path associated with the IP address and the port  
from the routing communication protocol stack to the  
selected communication protocol stack.

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address and listening to a predefined port of the single IP address in response to distribution by the routing communication protocol stack of an identification of the single IP address and the predefined port as a routable IP address.

15. A system according to Claim 13, wherein the routing communication protocol stack is further configured to incorporate into the current routing table routing paths associated with new connection messages received by the routing communication protocol stack from communication protocol stacks which initiate connections utilizing the single IP address and the predefined port as a source address.

16. A system according to Claim 13, wherein the routing communication protocol stack is further configured to receive requests for connections to the single IP address and the predefined port, select communication protocol stacks for the connections from the destination port table and update the current routing table with path information associated with the connections and the selected communication protocol stacks.

17. A system according to Claim 13, wherein the routing communication protocol stack is further configured to receive connection termination messages from communication protocol stacks which detect termination of connections utilizing the single IP address and predefined port and to update the current routing table to remove routing paths associated with the terminated connections.